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[54] **METHOD OF LUBRICATING A HOT STEEL WORKPIECE PRIOR TO HOT ROLLING**

[75] Inventors: **William G. Miller**, Penn Hills Township, Allegheny County; **Raymond E. Polinski**, Duquesne, both of Pa.

[73] Assignee: **United States Steel Corporation**, Pittsburgh, Pa.

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 75,394, Sept. 25, 1970, abandoned.

[52] **U.S. Cl.** **72/45,** 72/201
[51] **Int. Cl.** **B21b 45/02**
[58] **Field of Search** 72/41, 42, 43, 44, 45, 200, 72/201, 202, 236

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Primary Examiner—Charles W. Lanham
Assistant Examiner—E. M. Combs
Attorney, Agent, or Firm—Forest C. Sexton

[57] **ABSTRACT**

A method of lubricating a hot steel workpiece in the process of hot rolling wherein an undiluted lubricating oil is atomized and sprayed onto the hot steel surface. In order to prevent the oil from flashing and burning upon contact with the hot steel surface, the atomized oil particles are maintained within the range of about 150 to 250 microns in size.

1 Claim, 2 Drawing Figures

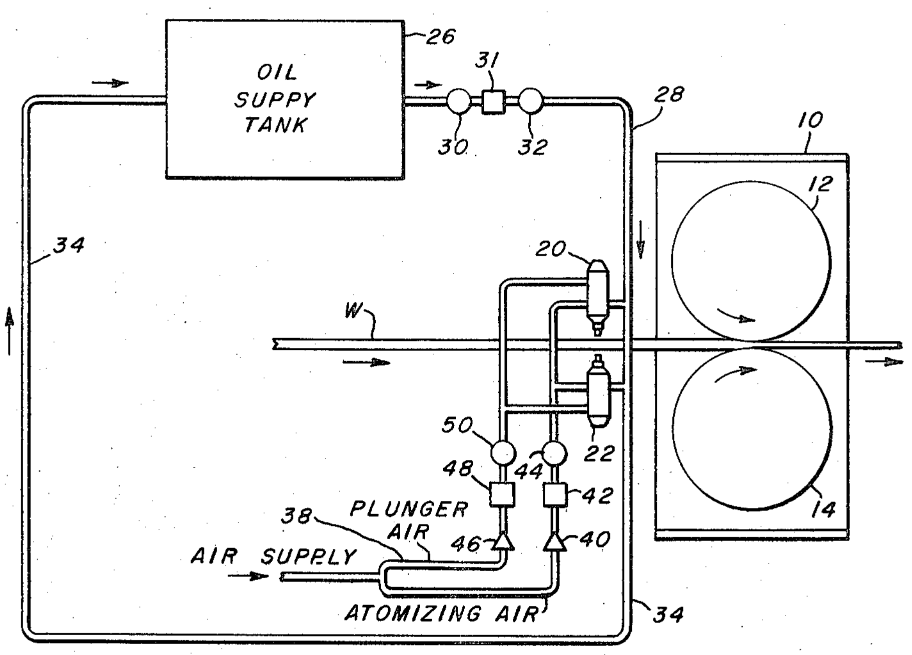


FIG. 1.

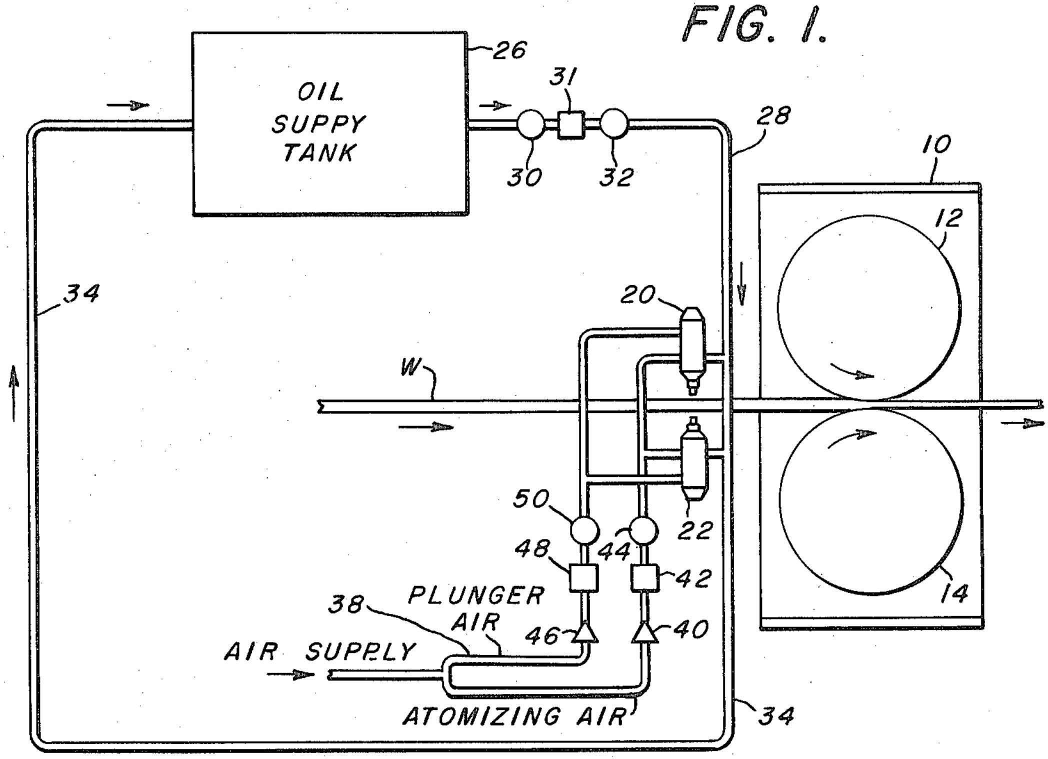
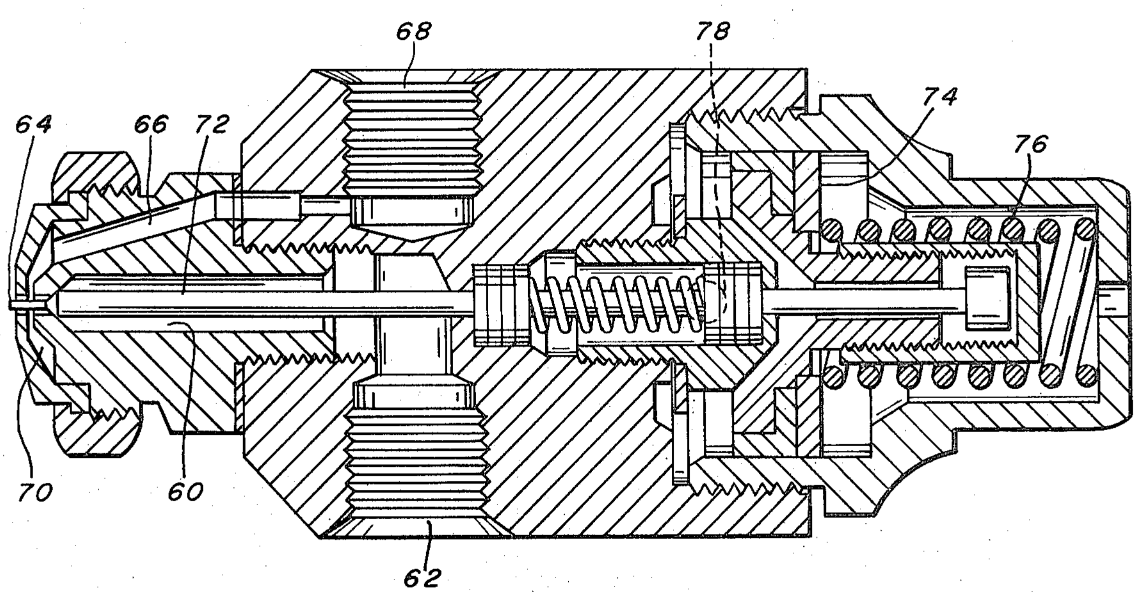


FIG. 2.



INVENTORS.
WILLIAM G. MILLER &
RAYMOND E. POLINSKI
By Forest C. Sexton
Attorney

METHOD OF LUBRICATING A HOT STEEL WORKPIECE PRIOR TO HOT ROLLING

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of application Ser. No. 75,394, filed Sept. 25, 1970, now abandoned.

It is generally well accepted that lubrication of a steel workpiece in the process of a hot rolling operation will provide several beneficial advantages, such as increased roll-life, superior surface on the rolled product, a more easily removed surface scale, and reduced power consumption. Although lubrication of the workpiece is common practice in cold rolling operations, it has rarely been applied to hot rolling and, when it has been attempted, results have usually been disappointing.

To be sufficiently economical for commercial processes, lubrication of a workpiece in the process of rolling is usually accomplished by applying either an oil-water mixture, or applying undiluted oil as an atomized spray. When oil and water mixtures are applied to a hot workpiece, a thin steam barrier is usually formed against the hot workpiece surface which prevents the oil from adhering thereto. In addition, the cooling water usually applied at the rolls will readily wash the oil-water mixture from the workpiece surface.

Because of the polar nature of most oils, undiluted applications thereof would not easily be washed from the workpiece surface. However, when undiluted oils are sprayed onto a hot workpiece surface in an atomized state, the oil will flash and burn-off at the usual hot rolling temperatures of 1,750° to 1,950°F.

Recently an improved system has been developed which overcomes the above problems. In that system, the lubricant is appplied to the backup rolls in conventional four-high rolling mills after stationary wipers have wiped the roll surface to remove any cooling water. The lubricant is then transferred from the backup rolls to the work rolls where the workpiece is lubricated. Although this system does overcome the above problems, it is obvious that it cannot be applied to a two-high rolling mill having no backup rolls, and frequently having a non-flat surface which cannot be wiped to remove cooling water. An example thereof would be the typical two-high finishing mill having a plurality of grooves around the rolls as used to roll reinforcement bars. Hot rolling in conventional two-high mills, therefore, is almost always done without the use of a lubricant.

SUMMARY OF THE INVENTION

Although undiluted lubricating oils will indeed flash and burn-off of a hot workpiece when sprayed thereon in accordance with conventional prior art practices, we have discovered that atomized oils will not burn when sprayed onto a hot workpiece if the atomized particles are sufficiently large, i.e., at least about 150 microns in size.

It is, therefore, an object of this invention to provide a method of spraying undiluted lubricating oil onto a hot workpiece without the oil burning therefrom.

Another object of this invention is to provide a method and apparatus for applying an undiluted lubricating oil onto a hot workpiece prior to hot rolling.

Still another object of this invention is to provide an apparatus for lubricating a hot workpiece which is particularly adaptable to a two-high rolling mill.

These and other objects will be more apparent after referring to the attached drawings and following description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of one embodiment of the apparatus of this invention as utilized in combination with a conventional two-high rolling mill; and

FIG. 2 is an enlarged sectional view of an atomizing nozzle as may be used in this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

All prior art systems for spraying an atomized lubricant onto a workpiece to be rolled have produced and sprayed atomized particles substantially less than 150 microns in size. When sprayed onto a hot workpiece at temperatures above about 1,600°F, the atomized lubricant will flash and burn-off as noted above. The crux of this invention is predicated upon our discovery that such atomized oil particles will not burn if the particle size thereof is at least about 150 microns.

In the practice of this invention, preheated oil is atomized and sprayed onto a hot workpiece while maintaining the atomized oil particles within the approximate range 150 to 250 microns in size. As previously noted, the minimum particle size limit of about 150 microns is necessary to avoid flashing and burn-off when the oil particles first contact the hot workpiece. The upper size limit of about 250 microns is essential to assure a thin uniform oil coating on the workpiece. That is to say, if the sprayed oil particles exceed about 250 microns in size, there is a tendency to produce a spotty, non-uniform oil coverage on the workpiece.

Although the larger oil particles will not flash upon initial contact with the hot workpiece as noted above, prolonged contact with the hot workpiece may well cause the oil to eventually ignite and burn. Therefore, it is preferred that the actual oil spray be applied as late as possible prior to the roll-bite, thereby minimizing the time between lubrication and hot rolling. Once hot rolling is commenced, the cooling water cascading down the roll surfaces will prevent oil ignition.

Because the oil particles sprayed in accordance with this invention are quite large and massive in contrast to conventional atomized sprays, it is preferred that the spray be directed perpendicularly to the workpiece with a narrow spray angle to avoid deflection of the oil particles off of the workpiece surface.

Many small two-high rolling mills have enclosed, bell-shaped guide boxes which serve to guide the workpiece through a predetermined portion of the work rolls. Since these guide boxes are necessarily close to the rolls, it may be difficult on some mills to suitably position the spray nozzles **20** and **22** between such a guide box and the rolls. Nevertheless, the spray nozzles should be positioned therebetween rather than ahead of the guide box so that the time between lubrication and rolling is minimized thereby minimizing the chances of oil ignition. The guide box may present another problem in that the confined space therein is usually quite hot and, frequently, any oil spray that is deflected thereinto will readily flash. Therefore, when working close to such a guide box, we have found it necessary to position the nozzles at a slight angle away from the guide box to minimize lubricant spray entering the hot confined space therein.

One embodiment of the apparatus used in the practice of this invention is schematically illustrated in FIG. **1**, where the numeral **10** indicates a conventional two-high rolling mill having an upper and lower roll **12** and **14**, respectively. A conventional hot workpiece W is being processed through mill **10**.

In accordance with this invention, at least one spray nozzle **20** is provided above the workpiece W a short distance from the mill **10** on the inlet side, and at least one spray nozzle **22** is provided below nozzle **20**. The number of nozzles **22** and **24** will of course depend upon the width of the workpiece W and the width of the spray at the workpiece surface. When hot rolling narrow materials such as rods, strapping stock, rebar stock and the like, then one nozzle on each side of workpiece W will be more than sufficient. When rolling wider materials, such as bumper stock, several nozzles may be necessary to completely cover the workpiece surface with lubricant.

The undiluted lubricating oil is supplied from oil storage tank **26** via oil supply line **28**. Control of the oil supply is provided by pump **30**, regulator **31** and gage **32** on oil supply line **28**. Unused oil is returned to tank **26** via oil return line **34**.

Atomizing air is supplied to nozzles **20** and **22** via atomizing air line **36**, while plunger air is supplied via plunger air line **38**. Control of atomizing air at the nozzles **20,22** is effected by providing a solenoid **40**, a regulator **42** and a gage **44** on atomizing air line **36**. In a like manner, a solenoid, regulator and gage, **46, 48** and **50** respectively, are provided on plunger air line **38**.

For optimum results, we have preferred to use commercially available nozzles manufactured by Spray Systems, Inc., and identified as Model 1/4 JAU. This nozzle, shown in detail in FIG. **2**, features automatic shut-off and clean-out mechanisms enabling the system to be kept under pressure at all times without clogging. This nozzle is particularly desirable for use in this invention because it is readily capable of producing the essential large sized oil particles by merely controlling atomizing air pressure. In addition, this nozzle will provide an economical oil output by a mere oil pressure adjustment, and the preferred narrow application band can easily be adjusted.

As shown in FIG. **2**, the preferred nozzle mentioned above is provided with a central opening **60** which receives the oil via oil inlet **62** and delivers it to the oil outlet opening **64**. Passage **66** receives atomizing air from atomizing air inlet **68** and delivers it to atomizing

air outlets **70**. A clean-out and shut-off needle **72** is received in opening **60** and has a piston **74** attached thereto which is urged by spring **76** to the closed position. Piston **74** is moved to the open position by means of plunger air introduced through opening **78**.

In operation, the lubricating oil preheated to a suitable temperature, is pumped by pump **30**, from tank **26** to the nozzles **20** and **22**. The pressure thereof is controlled by regulator **31**. Excess oil is returned to tank **26** via return line **34**. At the same time, atomizing air is supplied to nozzles **20** and **22** via line **38** by opening solenoid **40** and regulating the pressure with regulator **42**. To commence spraying, solenoid **46** is opened to activate nozzles **20** and **22** and thereby spray lubricating oil onto workpiece W. After the desired oil output is obtained by regulating regulator **31**, the atomized oil particle size can be regulated to the desired size by suitable adjustment of the atomizing air pressure with regulator **42**.

Suitable operating parameters are dependent upon so many variables that the limits thereof cannot be presented here. Nevertheless, these operating parameters can be readily determined experimentally. For any given system, given lubricant and given temperature, the desired lubricant particle size is readily attained by proper ratio adjustment of oil output regulator **31** and atomizing air regulator **42**.

For example, in our system, having the Model 1/4 JAU nozzles with **0.028** inch oil orifices, and utilizing a lubricant having a viscosity of approximately **200** SUS (Saybolt Universal Seconds) at **130°F**, the following oil and air parameters at each nozzle will produce oil particles within the range **150** to **250** microns:

Oil Rate	Oil Pressure	Air Rate	Air Pressure
10 gm./min	1½ psi	0.25 ft^3/min.	¾ psi
18 gm./min.	1¾ psi	0.30 ft^3/min.	1 psi
34 gm./min.	2 psi	0.40 ft^3/min.	1½ psi

Because of differences in viscosities between lubricants and differences in piping frictions from one system to the next, each system and lubricant used should be calibrated for nozzle output at various oil pressures.

We claim:

1. A method of lubricating a steel workpiece in the process of hot rolling which comprises heating the steel workpiece to a temperature above about 1,600°F, atomizing an undiluted lubricating oil to form particles thereof within the size range of about 150 to 250 microns, and spraying the atomized lubricating oil directly onto the hot workpiece surface.

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